

SUMEX
STANFORD UNIVERSITY
MEDICAL EXPERIMENTAL COMPUTER RESOURCE
RR-00785

ANNUAL REPORT – YEAR 16

Submitted to

BIOMEDICAL RESEARCH TECHNOLOGY PROGRAM
NATIONAL INSTITUTES OF HEALTH

June 1, 1989

STANFORD UNIVERSITY SCHOOL OF MEDICINE

Edward H. Shortliffe, Principal Investigator
Edward A. Feigenbaum, Co-Principal Investigator

DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
NATIONAL INSTITUTES OF HEALTH

DIVISION OF RESEARCH RESOURCES
BIOMEDICAL RESEARCH TECHNOLOGY PROGRAM

ANNUAL PROGRESS REPORT
PART I., TITLE PAGE

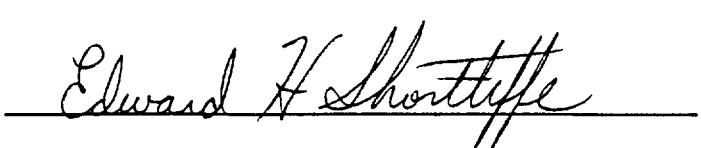
1. PHS GRANT NUMBER: 5 P41 RR00785-16
2. TITLE OF GRANT: SUMEX — Stanford University Medical Experimental Computer Resource
3. NAME OF RECIPIENT INSTITUTION: Stanford University
4. HEALTH PROFESSIONAL SCHOOL: School of Medicine
5. REPORTING PERIOD:
 - 5a. FROM: 08-01-88
 - 5b. TO: 07-31-89
6. PRINCIPAL INVESTIGATOR:
 - 6a. NAME: Edward H. Shortliffe, M.D., Ph.D.
 - 6b. TITLE: Associate Professor of Medicine and Computer Science
- 6c. SIGNATURE: 
7. DATE SIGNED: June 1, 1989
8. TELEPHONE: 415-723-6979

Table of Contents:

I. Title Page	1
II. Description of Program Activities	3
II.A. Scientific Subprojects	3
II.B. Books, Papers, and Abstracts	3
II.C. Resource Summary Table	3
III. Narrative Description.....	5
III.A. Summary of Research Progress	5
III.A.1 Resource Overview	5
III.A.1.1 SUMEX-AIM as a Resource	5
III.A.1.2 Significance and Impact in Biomedicine	11
III.A.1.3 Summary of Current Resource Goals	12
III.A.2 Details of Technical Progress.....	16
III.A.2.1 Key Areas of Progress	16
III.A.2.3. Core ONCOCIN Research	26
(1) Overview of the ONCOCIN Therapy Planning System	26
(2) Implementation of the ONCOCIN Workstation in the Stanford Clinic	27
(3) E-ONCOCIN: Domain Independent Therapy Planning	28
(4) OPAL: Graphical Knowledge Acquisition Interface.....	29
(5) Generalized Knowledge Acquisition through PROTÉGÉ	31
(6) Speech Input to Expert Systems	31
(6.1) Prototype Speech Hardware/Software System	31
(6.2) Speech Experiments	33
(7) Object Language Support for ONCOCIN Project.....	34
(8) Personnel	34
III.A.2.2. Core AI Research	36
(1) Rationale.....	36
(2) Highlights of Progress.....	37
(2.1) Large Multi-use Knowledge Bases for Science and Engineering	37
(2.2) Adaptive Intelligent Systems	40
(2.3) Advanced Architectures.....	41
(2.4) Knowledge Acquisition and Machine Learning	45
(2.5) Symbolic Simulation.....	45
III.A.2.4. Core System Research and Development.....	47
(1) Introduction and Overview	47

(2) The Phase-Out of the DECSYSTEM-20.....	49
(3) The New SUN-Based SUMEX-AIM Resource.....	51
(3.1) File Access and Management.....	52
(3.2) The SUMEX Perpetual Archive System.....	53
(3.3) Printing Services.....	55
(4) Electronic Mail	56
(4.1) Macintosh client - MacMM.....	58
(4.2) Mail Reader User-Interface.....	58
(4.3) The Mail Composition User Interface	60
(4.4) Texas Instruments Explorer Client.....	60
(4.5) DEC-20 IMAP2 Server	60
(4.6) UNIX IMAP2 Server.....	61
(4.7) Transition Strategy and Plan.....	62
(5) Lisp Systems.....	62
(5.1) Standards	62
(5.2) Lisp System Performance.....	63
(5.3) Lisp Programming Environments	65
(6) Workstation System Environments	66
(6.1) Macintosh II Workstations.....	66
(6.2) Texas Instruments Explorers.....	68
(6.3) SUN Workstations	72
(6.4) NeXT Workstations	73
(6.5) Xerox D-Machines.....	75
(6.6) Symbolics Lisp Machines	79
(6.7) HP 9836 Workstations.....	80
(7) Remote Workstation Access, Virtual Graphics, and Windows	80
(7.1) Remote Access	80
(7.2) Virtual Graphics and Windows.....	80
(7.3) Remote Graphics Applications.....	81
(8) Network Services	84
(8.1) National and Wide-Area Networks.....	84
(8.2) Local Area Networks - LAN's.....	86
(9) Distributed Information Resources and Access	88
(10) Distributed system operation and management	90
III.A.2.5. Relevant Core Research Publications.....	91
III.A.2.6. Resource Equipment.....	98
(1) Purchases This Past Year.....	98
(2) Current Subsystem Configurations	100

III.A.2.7. Training Activities	105
III.A.2.8. Resource Operations and Usage	108
(1) Operations and Support.....	108
(2) Resource Usage Details	108
(2.1) Overall Resource Loading Data.....	109
(2.2) Individual Project and Community Usage	110
III.B. Research Highlights	117
III.B.1. INTERNIST-I/QMR	118
III.B.2. PathFinder.....	119
III.B.3. The Distributed SUMEX-AIM Community	120
III.B.4. ONCOCIN	121
III.C. Administrative Changes.....	123
III.D. Resource Management and Allocation	124
III.D.1. Overall Management Plan.....	124
III.D.2. Cost Center.....	124
III.E. Dissemination of Resource Information	127
III.E.1. Software Distribution.....	127
III.E.2. AIM Community Systems Support.....	128
III.E.3. Video Tapes and Films.....	128
III.E.4. Special Seminars.....	128
III.F. Suggestions and Comments	129
III.F.1. Resource Organization	129
III.F.2. Electronic Communications	129
IV. Description of Scientific Subprojects.....	130
IV.A. Stanford Projects.....	131
IV.A.1. Guardian Project.....	132
IV.A.2. MOLGEN Project.....	137
IV.A.3. ONCOCIN Project.....	143
IV.A.4. PENGUIN Project.....	157
IV.A.5. PROTEAN Project	166
IV.A.6. Reasoning Under Uncertainty	174
IV.A.7. VentPlan Project.....	183
IV.B. National AIM Projects	190
IV.B.1. INTERNIST-I/QMR Project	191
IV.B.2. MENTOR Project.....	197

IV.C. Pilot Stanford Projects.....	202
IV.C.1. REFEREE Project.....	203
IV.D. Pilot AIM Projects.....	210
IV.D.1. The Pathfinder Project.....	211
Appendix A: Knowledge Systems Laboratory Brochure	219
Appendix B: Lisp Performance Studies	229
Appendix C: AIM Management Committee Membership.....	261

List of Figures:

Figure 1. NSFNet Configuration as of January 1989	85
Figure 2. SUMEX-AIM DEC 2060 Configuration	100
Figure 3. SUMEX-AIM SUN-4 Configuration.....	101
Figure 4. SUMEX-AIM SUN-3 File Server Configuration	101
Figure 5. SUMEX-AIM Xerox File Server Configuration.....	102
Figure 6. SUMEX-AIM VAX File Server Configuration.....	103
Figure 7. SUMEX-AIM Develcon X.25/TCP-IP Gateway Configuration	103
Figure 8. SUMEX-AIM Ethernet Configuration	104
Figure 9. Total CPU Hours Consumed by Month	110
Figure 10. CPU Usage Histogram by Project and Community	111
Figure 11. Table of Resource Use by Project	112